AMENDMENTS TO THE CLAIMS

Please cancel claims 1-18, 52-70, 99-106, and 112-114 without prejudice or disclaimer. A complete listing of all pending claims is shown below

1-18. (CANCELED).

19. (Original) A method of production of an optical device comprising a first optical portion made of a first optical material and having a concavity and a second optical portion comprising a second optical material having a refractive index different from that of the first optical material, and inserted into the concavity, including:

a step of injecting the first optical material into a metallic mold formed with a projection projecting out into a cavity to form the first optical portion made of the first optical material with a concavity reproducing the shape of the projection; and

a step of filling the second optical portion in the concavity of the molded.

20. (Original) A method of production of an optical device as set forth in claim 19, further comprising a step of flattening the surface of the second optical portion filled in the concavity.

21. (Original) A method of production of an optical device as set forth in claim 20, wherein;

the projection of the first optical portion has a substantially rotationally symmetric shape with respect to an optical axis, and the section of shape of the surface of the projection is an substantially arc, and

in the flattening step, the surface of the second optical portion is polished so that a flat plane substantially vertical with respect to the symmetry axis of the concavity reproducing the shape of the projection is formed.

22. (Original) A method of production of an optical device as set forth in claim 21, further comprising a step of polishing the first optical portion so that a flat surface substantially parallel to the surface of the flattened second optical portion is formed.

23. (Original) A method of production of an optical device as set forth in claim 19, the first optical material comprises titanium oxide, tantalum oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

24. (Original) A method of production of an optical device as set forth in claim 18, the second optical material comprises titanium oxide, tantalum oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

25. (Original) A method of production of an optical device comprising a first optical portion made of a first optical material and having a concavity and a second optical portion comprising a second optical material having a refractive index different from that of the first optical material, and inserted into the concavity, including:

a step of forming a resist having a hole in the flat surface of the first optical portion made of the first optical material;

a step of forming a concavity corresponding to the hole in the first optical portion by etching;

a step of removing a resist from the first optical portion with the concavity formed therein; and

a step of filling the second optical portion in the concavity of the first optical portion from which the resist is removed.

26. (Original) A method of production of an optical device as set forth in claim 25, further comprising a step of flattening the surface of the second optical portion filled in the concavity.

27. (Original) A method of production of an optical device as set forth in claim 26, wherein;

the hole is substantially circular,

the concavity has a substantially rotationally symmetric shape, and

in the flattening step, the surface of the second optical portion is polished so that a flat surface substantially vertical with respect to the symmetry axis of the concavity is formed.

28. (Original) A method of production of an optical device as set forth in claim 26, further comprising a step of polishing the first optical portion so that a flat surface

substantially parallel with respect to the surface of the flattened second optical portion is formed.

29. (Amended) A method of production of an optical device as set forth in claim 25, wherein;

the hole is substantially circular,

the concavity has a substantially rotationally symmetric shape, and

the shape of the surface of the concavity in the case when the concavity is cut along its symmetry axis is [an] substantially an arc.

30. (Original) A method of production of an optical device as set forth in claim 25, wherein the first optical material comprises titanium oxide, tantalum oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

31. (Original) A method of production of an optical device as set forth in claim 25, wherein the second optical material comprises titanium oxide, tantalum oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

32. (Original) A method of production of an optical device as set forth in claim 25, wherein the step of filling the second optical portion has

a step of filling the second optical portion in the concavity of the first optical portion from which the resist is removed and

a step of sealing the concavity filled with the second optical portion by a layer made of an optical material.

33. (Original) A method of production of an optical device as set forth in claim 32, wherein;

the layer for sealing the concavity is formed by a film having a substantially constant thickness, and

the second optical portion is an optical oil or liquid crystal.

34. (Original) A method of production of an optical device comprising a first optical portion made of a first optical material and having a concavity and a second optical portion comprising a second optical material having a refractive index different from that of the first optical material, and inserted into the concavity, including:

a step of forming on a third optical portion provided with a projection and having a flat area around the projection the first optical portion made of a layer of the first optical material burying the projection,

a step of flattening the surface of the first optical portion to form a flat surface and bonding the related flat surface to a third base material made of a third optical material,

a step of removing the third optical portion from the first optical portion bonded to the third base material to expose the concavity reproducing the shape of the projection in the first optical portion, and

a step of filling the second optical portion in the concavity of the exposed first optical portion.

35. (Original) A method of production of an optical device as set forth in claim 34, further comprising a step of flattening the surface of the second optical portion filled in the concavity.

36. (Original) A method of production of an optical device as set forth in claim 35, wherein

the projection has a substantially rotationally symmetric shape, and

in the flattening step, the surface of the second optical portion is polished so that a flat surface substantially vertical with respect to the symmetry axis of the concavity reproducing the shape of the projection is formed.

37. (Original) A method of production of an optical device as set forth in claim 35, further comprising a step of polishing the third base material so that a flat surface substantially parallel to the surface of the flattened second optical portion is formed.

38. (Amended) A method of production of an optical device as set forth in claim 34, wherein;

the projection has a substantially rotationally symmetric shape, and

the shape of the surface of the projection when the projection is cut along its symmetry axis is [an] substantially an arc.

39. (Original) A method of production of an optical device as set forth in claim 34, wherein the first optical material and the third optical material are identical optical materials.

40. (Original) A method of production of an optical device as set forth in claim 34, wherein the second optical portion is titanium oxide, tantalum oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

41. (Original) A method of production of an optical device as set forth in claim 34, wherein;

the second optical portion is a liquid-like optical material, and

the step of filling the second optical portion has

a step of filling the second optical portion in the concavity of the exposed first optical portion and

a step of sealing the concavity filled with the second optical portion by a layer made of an optical material.

42. (Original) A method of production of an optical device as set forth in claim 41, wherein;

the layer for sealing the concavity is formed by a film having a substantially constant thickness, and

the second optical portion is an optical oil or liquid crystal.

43. (Original) A method for production of an optical device having a first optical portion made of a first optical material and having a concavity and a second optical portion comprising a second optical material having a refractive index different from that of the first optical material, and inserted into the concavity, comprising:

a step of forming resist films having windows on substantially flat first and second flat surfaces facing each other of a first optical portion made of the first optical material;

a step of forming concavities corresponding to the windows in the first and second flat surfaces of the first optical portion by etching;

a step of removing the resist films from the first optical portion with the concavities formed therein; and

a step of filling the second optical portion in the concavities of the first and second flat surfaces of the first optical portion from which the resist films have been removed.

44. (Original) A method of production of an optical device as set forth in claim 43, further comprising a step of flattening the surface of the second optical portion filled in the concavities of the first and second flat surfaces.

45. (Original) A method of production of an optical device as set forth in claim 44, wherein

the windows are substantially circular,

the concavities have substantially rotationally symmetric shapes with respect to the optical axis, and

the flattening step has

a step of polishing the surface of the second optical portion filled in the concavity of the first flat surface so that a flat surface substantially vertical with respect to the symmetry axis of the concavity of the first flat surface is formed, and

a step of polishing the surface of the second optical portion filled in the concavity of the second flat surface so that a flat surface substantially vertical with respect to the symmetry axis of the concavity of the second flat surface is formed.

46. (Original) A method of production of an optical device as set forth in claim 43, wherein;

the second optical portion is a liquid-like optical material, and

the step of filling the second optical portion has a step of filling the second optical portion in the concavity of the first face of the first optical portion with the resist film removed therefrom and sealing the concavity of the related first face by a first layer made of the optical material and then filling the second optical portion in the concavity of the second face and sealing the concavity of the related second face by a second layer made of the optical material.

47. (Original) A method of production of an optical device as set forth in claim 46, wherein the second optical portion is an optical oil or liquid crystal.

48. (Original) A method for production of an optical device a first optical portion made of a first optical material and having a concavity and a second optical portion comprising a second optical material having a refractive index different from that of the first optical material, and inserted into the concavity, comprising:

a step of forming on a third optical portion provided with a first projection and having a flat area around the first projection a first optical portion made of a layer of the first optical material burying the first projection;

a step of forming on a fourth optical portion provided with a second projection and having a flat area around the second projection a third optical portion made of a layer of the first optical material burying the second projection;

a step of flattening the surface of the first optical portion to form a flat surface and bonding the related flat surface to a first flat surface among facing first and second flat surfaces of a fifth optical portion made of a third optical material;

a step of flattening the surface of the third optical portion to form a flat surface and bonding the related flat surface to the second flat surface of the fifth optical portion;

a step of removing the second and fourth optical portions from the first and third optical portions bonded to the fifth optical portion and exposing concavities with the shapes of the first and second projections transferred thereto in the first and third optical portions; and

a step of filling the second optical portion in the concavities of the exposed first and third optical portions.

49. (Original) A method of production of an optical device as set forth in claim 48, further comprising a step of flattening the surface of the second optical portion filled in the concavities of the first and third optical portions.

50. (Original) A method of production of an optical device as set forth in claim 49, wherein;

the first and second projections have substantially rotationally symmetric shapes with respect to the optical axis, and

the flattening step has

a step of polishing the surface of the second optical portion filled in the concavity of the first optical portion so that a flat surface substantially vertical with respect to the symmetry axis of the concavity of the first optical portion with the shape of the first projection transferred thereto is formed and

a step of polishing the surface of the second optical portion filled in the concavity of the third optical portion so that a flat surface substantially vertical with respect to the symmetry axis of the concavity of the third optical portion with the shape of the second projection transferred thereto is formed.

51. (Original) A method of production of an optical device as set forth in claim 50, wherein

the second optical portion is a liquid-like optical material, and

the step of filling the second optical portion has a step of filling the second optical portion in the concavity of the exposed first optical portion and sealing the concavity of the related first optical portion by a first layer made of the optical

material and then filling the second optical portion in the concavity of the third optical portion and sealing the concavity of the related third optical portion by a second layer made of the optical material.

52-70. Canceled.

71. (Original) A method for production of an optical device having a convex lens and a first optical portion closely contacting the convex curved face of this convex lens, comprising:

a step of using a metallic mold formed with a projection projecting out into a cavity to mold a first optical portion formed with a concavity reproducing the shape of the projection;

a step of filling an optical material in the concavity of the molded optical portion;

a step of flattening the surface of the optical material filled in the concavity to form the convex lens; and

a step of forming a hole so that part of the convex curved face closely contacting the concavity in the convex lens is exposed in the first optical portion.

72. (Original) A method of production of an optical device as set forth in claim 71, further comprising a step of polishing the first optical portion so that a flat surface parallel or substantially parallel with respect to the surface of the flattened optical material is formed.

73. (Original) A method of production of an optical device as set forth in claim 73, wherein the step of forming the hole in the first optical portion has

a step of forming a resist film having a window on the flat surface of the first optical portion formed in the step of polishing the first optical portion,

a step of forming a hole corresponding to the window in the first optical portion by etching, and

a step of removing the resist film from the first optical portion.

74. (Original) A method of production of an optical device as set forth in claim 73, wherein the window has a circular or substantially circular shape.

75. (Original) A method of production of an optical device as set forth in claim 73, wherein

the step of filling the optical material has

a step of forming a coating film covering the surface of the concavity of the mold optical portion and

a step of filling a optical material in the concavity formed with the coating film,

the step of forming the hole in the first optical portion has

a step of forming a resist film having a window on the flat surface of the first optical portion formed in the step of polishing the first optical portion,

a step of forming a hole reaching the coating film from the window in the first optical portion by etching,

a step of removing the resist film from the first optical portion formed with the hole, and

a step of removing the part of the coating film exposed in the hole.

76. (Original) A method of production of an optical device as set forth in claim 77, wherein the window has a circular or substantially circular shape.

77. (Original) A method of production of an optical device as set forth in claim 72, wherein

the projection has a rotationally symmetric or substantially rotationally symmetric shape, and

in the step of forming the convex lens, the surface of the optical material is polished so that a flat surface vertical or substantially vertical with respect to the symmetry axis of the concavity with the shape of the projection transferred thereto is formed.

78. (Original) A method of production of an optical device as set forth in claim 77, wherein the shape of the surface of the projection when the projection is cut along its symmetry axis is an arc or substantially arc.

79. (Original) A method of production of an optical device as set forth in claim 71, wherein the optical material is titanium oxide, tantalum oxide, niobium oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

80. (Original) A method for production of an optical device having a convex lens and a first optical portion closely contacting the convex curved face of this convex lens, comprising:

a step of forming a first resist film having a first window in the flat surface of the first optical portion;

a step of forming a concavity corresponding to the first window in the first optical portion by etching;

a step of removing the first resist film from the first optical portion formed with the concavity;

a step of filling an optical material in the concavity of the first optical portion from which the first resist film is removed;

a step of flattening the surface of the optical material filled in the concavity to form the convex lens; and

a step of forming a hole whereby part of the convex curved face closely contacting the concavity in the convex lens is exposed in the first optical portion.

81. (Original) A method of production of an optical device as set forth in claim 80, further comprising a step of polishing the first optical portion so that a flat surface parallel or substantially parallel with respect to the surface of the flattened optical material is formed.

82. (Original) A method of production of an optical device as set forth in claim 81, wherein the step of forming the hole in the first optical portion has

a step of forming a second resist film having a second window in the flat surface of the first optical portion formed in the step of polishing the first optical portion,

a step of forming a hole corresponding to the second window in the first optical portion by etching, and

a step of removing the second resist film from the first optical portion formed with the hole.

83. (Original) A method of production of an optical device as set forth in claim 82, wherein the second window has a circular or substantially circular shape.

84. (Original) A method of production of an optical device as set forth in claim 81, wherein

the step of filling the optical material has

a step of forming a coating film covering the surface of the concavity of the first optical portion from which the first resist film has been removed and

a step of filling an optical material in the concavity formed with the coating film, and

the step of forming the hole in the first optical portion has

a step of forming a second resist film having a second window in the flat surface of the first optical portion formed in the step of polishing the first optical portion,

a step of forming a hole reaching the coating film from the second window in the first optical portion by etching,

a step of removing the second resist film from the first optical portion formed with the hole, and

a step of removing a part exposed in the hole in the coating film.

85. (Original) A method of production of an optical device as set forth in claim 84, wherein the second window has a circular or substantially circular shape.

86. (Original) A method of production of an optical device as set forth in claim 80, wherein

the first window is circular or substantially circular,

the concavity has a rotationally symmetric or substantially rotationally symmetric shape, and

in the step of forming the convex lens, the surface of the optical material is polished so that a flat surface vertical or substantially vertical with respect to the symmetry axis of the concavity is formed.

87. (Original) A method of production of an optical device as set forth in claim 86, wherein the shape of the surface of the concavity when the concavity is cut along its symmetry axis is an arc or substantially arc.

88. (Original) A method of production of an optical device as set forth in claim 80, wherein the optical material is titanium oxide, tantalum oxide, niobium oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

89. (Original) A method for production of an optical device having a convex lens and a first optical portion closely contacting the convex curved face of this convex lens, comprising:

a step of forming on a third optical portion provided with a projection and having a flat area around the projection a first optical portion made of a layer burying the projection;

a step of flattening the surface of the first optical portion to form a flat surface and bonding the related flat surface to a third optical portion;

a step of removing the third optical portion from the first optical portion bonded to the third optical portion to expose the concavity with the shape of the projection transferred thereto in the first optical portion;

a step of filling an optical material in the exposed concavity of the first optical portion;

a step of flattening the surface of the optical material filled in the concavity to form the convex lens; and

a step of forming holes whereby part of the convex curved face closely contacting the concavity in the convex lens is exposed in the first and third optical portions.

90. (Original) A method of production of an optical device as set forth in claim 89, further comprising a step of polishing the third optical portion so that a flat surface parallel or substantially parallel with respect to the surface of the flattened optical material is formed.

91. (Original) A method of production of an optical device as set forth in claim 90, wherein

the step of forming the holes in the first and third optical portions has

a step of forming a resist film having a window in the flat surface of the third optical portion formed in the step of polishing the third optical portion,

a step of forming holes corresponding to the windows in the first and third optical portions by etching, and

a step of removing the resist films from the first and third optical portions formed with the holes formed.

92. (Original) A method of production of an optical device as set forth in claim 91, wherein the windows have circular or substantially circular shapes.

93. (Original) A method of production of an optical device as set forth in claim 90, wherein

the step of filling the optical material has

a step of forming a coating film covering the surface of the exposed concavity of the first optical portion and

a step of filling the optical material in the concavity formed with the coating film, and

the step of forming the hole in the first optical portion has

a step of forming a resist film having a window in the flat surface of the third optical portion formed in the step of polishing the third optical portion,

a step of forming holes reaching the coating film from the window in the first and third optical portions by etching,

a step of removing the resist films from the first and third optical portions formed with the holes formed, and

a step of removing the part exposed in the hole in the coating film.

94. (Original) A method of production of an optical device as set forth in claim 93, wherein the windows have circular or substantially circular shapes.

95. (Original) A method of production of an optical device as set forth in claim 89, wherein

the projection has a rotationally symmetric or substantially rotationally symmetric shape, and

in the step of forming the convex lens, the surface of the optical material is polished so that a flat surface vertical or substantially vertical with respect to the symmetry axis of the concavity with the shape of the projection transferred thereto is formed.

96. (Original) A method of production of an optical device as set forth in claim 95, wherein the shape of the surface of the projection when the projection is cut along its symmetry axis is an arc or substantially arc.

97. (Original) A method of production of an optical device as set forth in claim 89, wherein the first and third optical portions are made of an identical material.

98. (Original) A method of production of an optical device as set forth in claim 89, wherein the optical material is titanium oxide, tantalum oxide, niobium oxide, gallium phosphate, gallium nitride, a compound of titanium, niobium, and oxygen, a compound of titanium, tantalum, and oxygen, or silicon nitride.

99-106. (canceled)

107. (Original) A method for producing an optical device by using a metallic mold having a cavity into which an optical material in a molten state or softened state is to be filled and a pin for forming a concavity in the optical material in the molten state or softened state in the cavity, wherein the pin penetrates through the wall of the cavity from the outside and projects out into the cavity, comprising:

a step of filling the optical material in the molten state or softened state in the cavity to create a first optical portion formed with the concavity by a simple molding; and

a step of polishing or grinding the face of the first optical portion where the concavity is formed so that a hole of a front end of the concavity remains.

108. (Original) A method of production of an optical device as set forth in claim 107, wherein the hole of the front end of the concavity has a spherical or substantially spherical shape.

109. (Original) A method for producing an optical device by using a metallic mold having a cavity into which an optical material in a molten state or softened state is to be filled and a pin for forming a concavity in the optical material in the molten

state or softened state in the cavity, wherein the pin penetrates through the wall of the cavity from the outside and projects out into the cavity, comprising:

a step of filling the optical material in the molten state or softened state in the cavity to create a first optical portion formed with the concavity by simple molding;

a step of filling an optical material having a refractive index different from that of the first optical portion in the concavity of the first optical portion; and

a step of flattening the surface of the optical material filled in the concavity to form a convex lens made of the related optical material.

110. (Original) A method of production of an optical device as set forth in claim 109, further having a step of polishing or grinding the face of the first optical portion where the concavity is formed so that a hole of the front end of the concavity filled with the optical material having a different refractive index remains.

111. (Original) A method of production of an optical device as set forth in claim 109, wherein the hole of the front end of the concavity has a spherical or substantially spherical shape.

112-114. Canceled